

## What are Natural Hazards?

Natural hazards are physical events such as earthquakes and volcanoes that have the potential to do damage to humans and property. Hazards include tectonic hazards, tropical storms and forest fires.

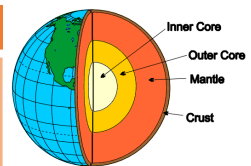
### What affects hazard risk?

Population growth  
Global climate change  
Deforestation  
Wealth - LICs are particularly at risk as they do not have the money to protect themselves



## Structure of the Earth

The earth has 4 layers  
The core (divided into inner and outer), mantle and crust.

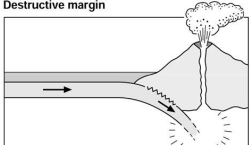
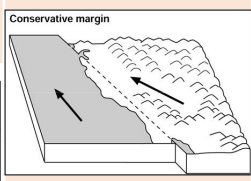
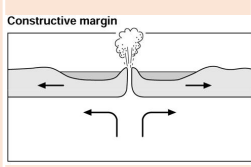


The crust is split into major sections called **tectonic plates**.

There are 2 types of crust: **Oceanic** (thin and younger but dense) and **Continental** (old and thicker but less dense).

These plates move due to convection currents in the mantle and, where they meet, tectonic activity (volcanoes and earthquakes) occurs..

Plates either move towards each other (**destructive margin**) away from each other (**constructive**) or past each other (**conservative**).



## Earthquakes and Volcanoes

### Volcanoes

- **Constructive margins** – Hot magma rises between the plates e.g. Iceland. Forms Shield volcanoes.  
- **Destructive margins** – an oceanic plate subducts under a continental plate. Friction causes oceanic plate to melt and pressure forces magma up to form composite volcanoes e.g. the west coast of South America.

### Earthquakes

- **Constructive margins** – usually small earthquakes as plates pull apart.  
- **Destructive margins** – violent earthquakes as pressure builds and is then released.  
- **Conservative margins** – plates slide past each other. They catch and then as pressure builds it is released e.g. San Andreas fault.

## Effects of Tectonic Hazards?

Primary effects happen immediately. Secondary effects happen as a result of the primary effects and are therefore often later.

Primary - Earthquakes	Secondary - Earthquakes
<ul style="list-style-type: none"> <li>- Property and buildings destroyed.</li> <li>- People injured or killed.</li> <li>- Ports, roads, railways damaged.</li> <li>- Pipes (water and gas) and electricity cables broken.</li> </ul>	<ul style="list-style-type: none"> <li>- Business reduced as money spent repairing property.</li> <li>- Blocked transport hinders emergency services.</li> <li>- Broken gas pipes cause fire.</li> <li>- Broken water pipes lead to a lack of fresh water.</li> </ul>

Primary - Volcanoes	Secondary - Volcanoes
<ul style="list-style-type: none"> <li>- Property and farm land destroyed.</li> <li>- People and animals killed or injured.</li> <li>- Air travel halted due to volcanic ash.</li> <li>- Water supplies contaminated.</li> </ul>	<ul style="list-style-type: none"> <li>- Economy slows down. Emergency services struggle to arrive.</li> <li>- Possible flooding if ice melts Tourism can increase as people come to watch.</li> <li>- Ash breaks down leading to fertile farm land.</li> </ul>

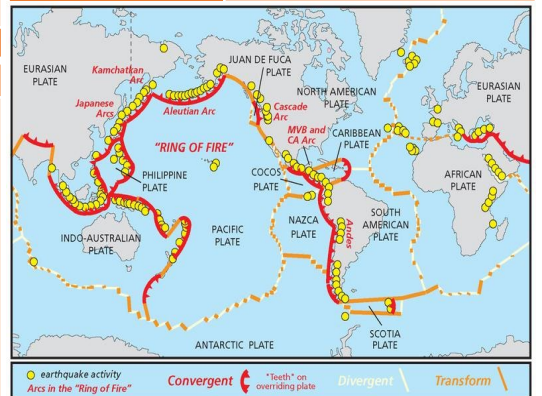
## Responses to Tectonic Hazards

Immediate (short term)	Long-term
<ul style="list-style-type: none"> <li>- Issue warnings if possible.</li> <li>- Rescue teams search for survivors.</li> <li>- Treat injured.</li> <li>- Provide food and shelter, food and drink.</li> <li>- Recover bodies.</li> <li>- Extinguish fires.</li> </ul>	<ul style="list-style-type: none"> <li>- Repair and re-build properties and infrastructure.</li> <li>- Improve building regulations</li> <li>- Restore utilities.</li> <li>- Resettle locals elsewhere.</li> <li>- Develop opportunities for recovery of economy.</li> <li>- Install monitoring technology.</li> </ul>



# Unit 1a The Challenge of Natural Hazards

**Distribution of tectonic activity**  
Along plate boundaries.  
On the edge of continents.  
Around the edge of the Pacific.



## Comparing Earthquakes – Nepal and New Zealand

**Nepal. April 2015. Magnitude 7.8.**  
9000 deaths  
23000 injured  
Over 500,000 homes destroyed  
Historic buildings destroyed  
1.4 million people needed food, water, shelter  
26 hospitals and 50% of schools destroyed

**New Zealand. February 2011. Magnitude 6.3.**  
180 deaths  
2000 injuries  
Road and bridges were severely damaged  
Christchurch cathedral lost its spire  
Cars and buses crushed  
Christchurch cathedral lost spire

Primary Effects	
<ul style="list-style-type: none"> <li>-Avalanche on Mount Everest killing 19 people.</li> <li>-Loss of income from tourism (which was 8.9% of Nepal's GDP).</li> <li>-Rice seed stored in homes was ruined as homes collapsed. This caused food shortages.</li> </ul>	<ul style="list-style-type: none"> <li>-Landslides in some suburbs caused serious damage to buildings</li> <li>-Schools had to share classrooms because of the damage to other school buildings</li> <li>-Christchurch could no longer host Rugby World Cup matches so lost the benefits, e.g. tourism and income, they would bring</li> </ul>

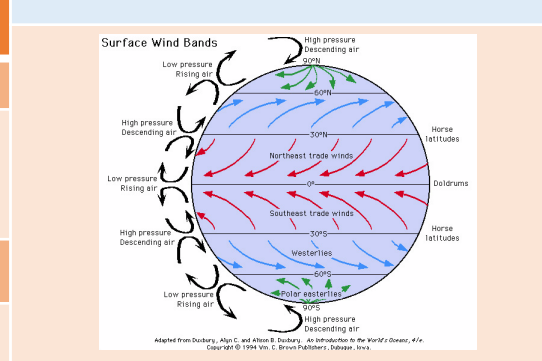
Immediate Responses	
<p>Nepal requested international help. UK's DEC raised \$126 million. Red Cross- tents for 225,000 people. UN and WHO distributed medical supplies to the worst districts. Facebook launched a safety feature so people could indicate they were safe.</p>	<p>Chemical toilets provided for 30000 people Bottled water was supplied Search and rescue teams came from UK, USA etc International aid (money) was sent from various countries</p>

Long term responses	
<p>Rebuilding. World Heritage Sites reopen June 2015. Longer climbing season.</p>	<p>Water and sewerage was restored Rebuilding \$900 million paid in building claims</p>



## Global atmospheric circulation

At the equator, the sun's rays are most concentrated. This means it is hotter. This one fact causes global atmospheric circulation at different latitudes.

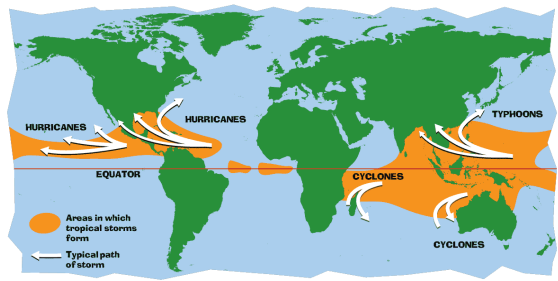


High pressure = dry  
Low pressure = wet  
As the air heats it rises – causing low pressure. As it cools, it sinks, causing high pressure. Winds move from high pressure to low pressure. They curve because of the **Coriolis effect** (the turning of the

LICs suffer more than HICs from natural disasters because they are not as prepared and struggle to react effectively.

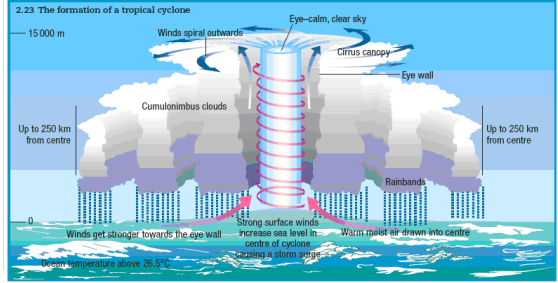
## Tropical Storms

Occur in low latitudes between 5° and 30° north and south of the equator (in the tropics). Ocean temperature needs to be above 27° C. Happen between summer and autumn.



## Sequence of a Tropical Storm

- Air is heated above warm tropical oceans.
- Air rises under low pressure conditions.
- Strong winds form as rising air draws in more air and moisture causing torrential rain.
- Air spins due to Coriolis effect around a calm eye of the storm.
- Cold air sinks in the eye so it is clear and dry.
- Heat is given off as it cools powering the storm.
- On meeting land, it loses source of heat and moisture so loses power.



Climate change will affect tropical storms too. Warmer oceans will lead to more intense storms – but not necessarily more frequent ones.

## Extreme weather in the UK

- Rain** – can cause flooding damaging homes and business.
- Snow & Ice** – causes injuries and disruption to schools and business. Destroys farm crops.
- Hail** – causes damage to property and crops.
- Drought** – limited water supply can damage crops.
- Wind** – damage to property and damage to trees potentially leading to injury.
- Thunderstorms** – lightning can cause fires or even death.
- Heat waves** – causes breathing difficulties and can disrupt travel.

UK weather is getting more extreme due to climate change. Temperatures are more extreme and rain is more frequent and intense leading to more flooding events. Since 1980 average temperature has increased 1 degree and winter rainfall has increased.

## Typhoon Haiyan, Philippines, November 2013

Primary Effects	Secondary Effects
At least 6340 killed 314 km/hr wind speeds. 5m Storm Surge 90% buildings in Tacloban destroyed Habitats & Crops destroyed	\$14 Billion of damage Water supply polluted 130,000 houses destroyed, leaving 4.2 million homeless Public Order – Looting Airports unusable for supplies

Immediate Responses	Long-term Responses
1,069 emergency shelters set up in public buildings. Disaster Emergency Committee helped 3,316,500 people outside these centres by providing aid. UK aid charities provided shelter, food and medical supplies.	UN appeal raised \$300 million. Typhoon warning systems have been improved. People are now better educated about how to respond.

Prediction	Planning	Protection
Monitoring wind patterns allows path to be predicted. Use of satellites to monitor path to allow evacuation	Avoid building in high risk areas Emergency drills Evacuation routes	Reinforced buildings and stilts to make safe Flood defences e.g. levees and sea walls Replanting Mangroves

## December 2013 – February 2014 - Somerset Levels Flood

Somerset area had wettest January since records began. 350 mm of rain fell in 2 months. Rivers had not been dredged in over 20 years.. Area at high risk of floods.

Social Effects
600 houses flooded 16 farms evacuated Residents evacuated to temporary accommodation for several months Power supplies were cut off

Economic Effects
Caused £10 million damage to Somerset County council Over 14 000 hectares of agricultural land was under water for 4 weeks Over 1000 livestock evacuated Local roads cut off by floods

Environmental impacts
Floodwaters contaminated with sewage A large amount of debris needed to be cleaned up Stagnant water needed to be reoxygenated before going back to rivers

Management strategies	Managing Climate Change
<b>Immediate Response:</b> Villagers had to use boats to get around town Volunteers from other communities helped <b>Long Term:</b> Flood Action Plan to reduce risk in future Rivers were dredged Major roads have been raised River banks are raised and strengthened Vulnerable communities given flood defences	<b>Mitigation</b> <ul style="list-style-type: none"> <li>- <b>Alternative energy production</b> will reduce CO<sub>2</sub> production.</li> <li>- <b>Planting Trees</b> – helps to remove carbon dioxide.</li> <li>- <b>Carbon Capture</b> – takes carbon dioxide from emission sources is stored underground.</li> <li>- <b>International Agreements</b> e.g. the Paris Climate Agreement.</li> </ul>

## Climate Change – natural or human?

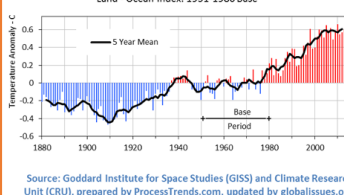
Evidence for climate change shows changes before humans were on the planet. So some of it must be natural. However, the rate of change since the 1970s is unnatural. Humans are responsible – despite what Mr Trump says!

Causes				
<table border="1"> <thead> <tr> <th>Natural</th> <th>Human</th> </tr> </thead> <tbody> <tr> <td> <ul style="list-style-type: none"> <li>- <b>Orbital changes</b> – The sun's energy on the Earth's surface changes as the Earth's orbit is elliptical its axis is tilted on an angle.</li> <li>- <b>Solar Output</b> – sunspots increase to a maximum every 11 years.</li> <li>- <b>Volcanic activity</b> – volcanic aerosols reflect sunlight away reducing global temperatures temporarily.</li> </ul> </td> <td> <ul style="list-style-type: none"> <li>- <b>Fossil fuels</b> – release carbon dioxide with accounts for 50% of greenhouse gases.</li> <li>- <b>Agriculture</b> – accounts for around 20% of greenhouse gases due to methane production from cows etc.</li> <li>- Larger populations and growing demand for met and rice increase contribution.</li> <li>- <b>Deforestation</b> – logging and clearing land for agriculture increases carbon dioxide in the atmosphere and reduces ability to planet to absorb carbon through photosynthesis.</li> </ul> </td> </tr> </tbody> </table>	Natural	Human	<ul style="list-style-type: none"> <li>- <b>Orbital changes</b> – The sun's energy on the Earth's surface changes as the Earth's orbit is elliptical its axis is tilted on an angle.</li> <li>- <b>Solar Output</b> – sunspots increase to a maximum every 11 years.</li> <li>- <b>Volcanic activity</b> – volcanic aerosols reflect sunlight away reducing global temperatures temporarily.</li> </ul>	<ul style="list-style-type: none"> <li>- <b>Fossil fuels</b> – release carbon dioxide with accounts for 50% of greenhouse gases.</li> <li>- <b>Agriculture</b> – accounts for around 20% of greenhouse gases due to methane production from cows etc.</li> <li>- Larger populations and growing demand for met and rice increase contribution.</li> <li>- <b>Deforestation</b> – logging and clearing land for agriculture increases carbon dioxide in the atmosphere and reduces ability to planet to absorb carbon through photosynthesis.</li> </ul>
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## Effects of Climate Change

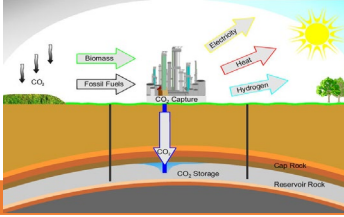
Social	Environmental
<ul style="list-style-type: none"> <li>- Increased disease e.g. skin cancer and heat stroke.</li> <li>- Winter deaths decrease with milder winters.</li> <li>- Crop yields affected by up to 12% in South America but will increase in Northern Europe but will need more irrigation.</li> <li>- Less ice in Arctic Ocean increases shipping and extraction of oil and gas reserves.</li> <li>- Droughts reduce food and water supply in sub-Saharan Africa. Water scarcity in South and South East UK.</li> <li>- Increased flood risk. 70% of Asia is at risk of increased flooding</li> <li>- Declining fish in some areas affect diet and jobs.</li> <li>- Increased extreme weather</li> <li>- Skiing industry in Alps threatened.</li> </ul>	<ul style="list-style-type: none"> <li>- Increased drought in Mediterranean region.</li> <li>- Lower rainfall causes food shortages for orangutans in Borneo and Indonesia.</li> <li>- Sea level rise leads to flooding and coastal erosion.</li> <li>- Ice melts threaten habitats of polar bears.</li> <li>- Warmer rivers affect marine wildlife.</li> <li>- Forests in North America may experience more pests, disease and forest fires.</li> <li>- Coral bleaching and decline in biodiversity.</li> </ul>

## Global Temperature, 1880 - 2014



## Evidence for Climate Change

- **The Met Office has reliable climate evidence since 1914 – but we can tell what happened before that using several methods.**
- **Ice and Sediment Cores**
  - Ice sheets are made up of layers of snow, one per year. Gases trapped in layers of ice can be analysed. Ice cores from Antarctica show changes over the last 400 000 years.
  - Remains of organisms found in cores from the ocean floor can be traced back 5 million years.
- **Pollen Analysis**
  - Pollen is preserved in sediment. Different species need different climatic conditions.
- **Tree Rings**
  - A tree grows one new ring each year. Rings are thicker in warm, wet conditions
  - This gives us reliable evidence for the last 10 000 years.
- **Temperature Records**
  - Historical records date back to the 1850s. Historical records also tell us about harvest and weather reports.



Adaption
<ul style="list-style-type: none"> <li>- <b>Changes in agricultural systems</b> need to react to changing rainfall and temperature patterns and threat of disease and pests.</li> <li>- <b>Managing water supplies</b> – eg. by installing water efficient devices and increasing supply through <b>desalination</b> plants.</li> <li>- <b>Reducing risk</b> from rising sea levels would involve constructing defences such as the Thames Flood Barrier or restoring mangrove forests, or raising buildings on stilts.</li> </ul>